PROJECT MANAGEMENT

Memorandum of

ONTARIO HYDRO

to the

Royal Commission

On Electric Power Planning

with respect to the

Public Information Hearings

May 1976

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7. PROJECT MANAGEMENT

7.1 INTRODUCTION

This memorandum describes the Project Management practices of the Design and Construction Branch through which the engineering and construction of Hydro's capital facilities are controlled beyond the stage where the type of plant has been decided upon and its location is known. In terms of organizational involvement the phase of the work described in this memorandum is the concern of the Generation Projects Division and Stations, Transmission and Distribution Division. It generally follows with some overlaps the work of the Route and Site Selection Division and Design and Development Division.

These Project Management practices are outlined through descriptions of the organization and resources involved, the planning and control processes, procurement management, and commissioning. The main emphasis is on those features concerned with major generation projects since these account for the greatest portion of the work in terms of expenditures. Project Management practices governing Stations, Transmission and Distribution work are essentially the same in concept varying only in detail as dictated by the character of the work involved.

7.2 ORGANIZATION AND RESOURCES

7.2.1 DESIGN AND CONSTRUCTION BRANCH RESPONSIBILITY

The responsibility of the Design and Construction Branch is to design and build integrated generation, transformation, transmission and distribution facilities for the supply of electrical energy.

In carrying out this responsibility, the following specific criteria apply:

Safety	- Maximum practicably achievable
Reliability	- Equivalent to the best provided similar communities on the North American Continent
Environment	- Minimum feasible impact on the environment
Cost	- Minimum delivered cost per kilowatt hour

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7.2.2 Organization of Design and Construction Branch

The Design and Construction Branch is a major organizational unit within Ontario Hydro comprising some 9,000 employees, plus about 5,500 contractor and consultant staff. It is headed by the General Manager - Design and Construction, who is accountable for the direction and performance of four Divisions plus an Administrative Systems group.

In recognition of longer lead times in site and project approvals, to provide improved plant and system reliability as these become more complex, and to minimize effects of severe overall escalation of costs, a re-organization was carried out on January 1, 1976.

The following are brief outlines of the character and role of each major component of the Design and Construction Branch: (Figure 7-1)

Generation Projects Division:

All design and construction forces, both internal and external, engaged on major generation and heavy water production projects are directed through this division.

A Project Management approach is applied on all major projects with Project Managers being held accountable for the successful completion of each job within prescribed performance, time and cost commitments.

Stations, Transmission and Distribution Division:

Forces required to produce Stations and Transmission plant are contained in this Division, working through three major functions: Program Management, Design, Construction.

Defined programs of work comprising either a single class of plant or all components in a section of the power delivery system, whichever is appropriate, are controlled by Program Managers. These managers co-ordinate the required inputs of design and construction and are accountable to the Director for completion of the work within commitments to time and cost.

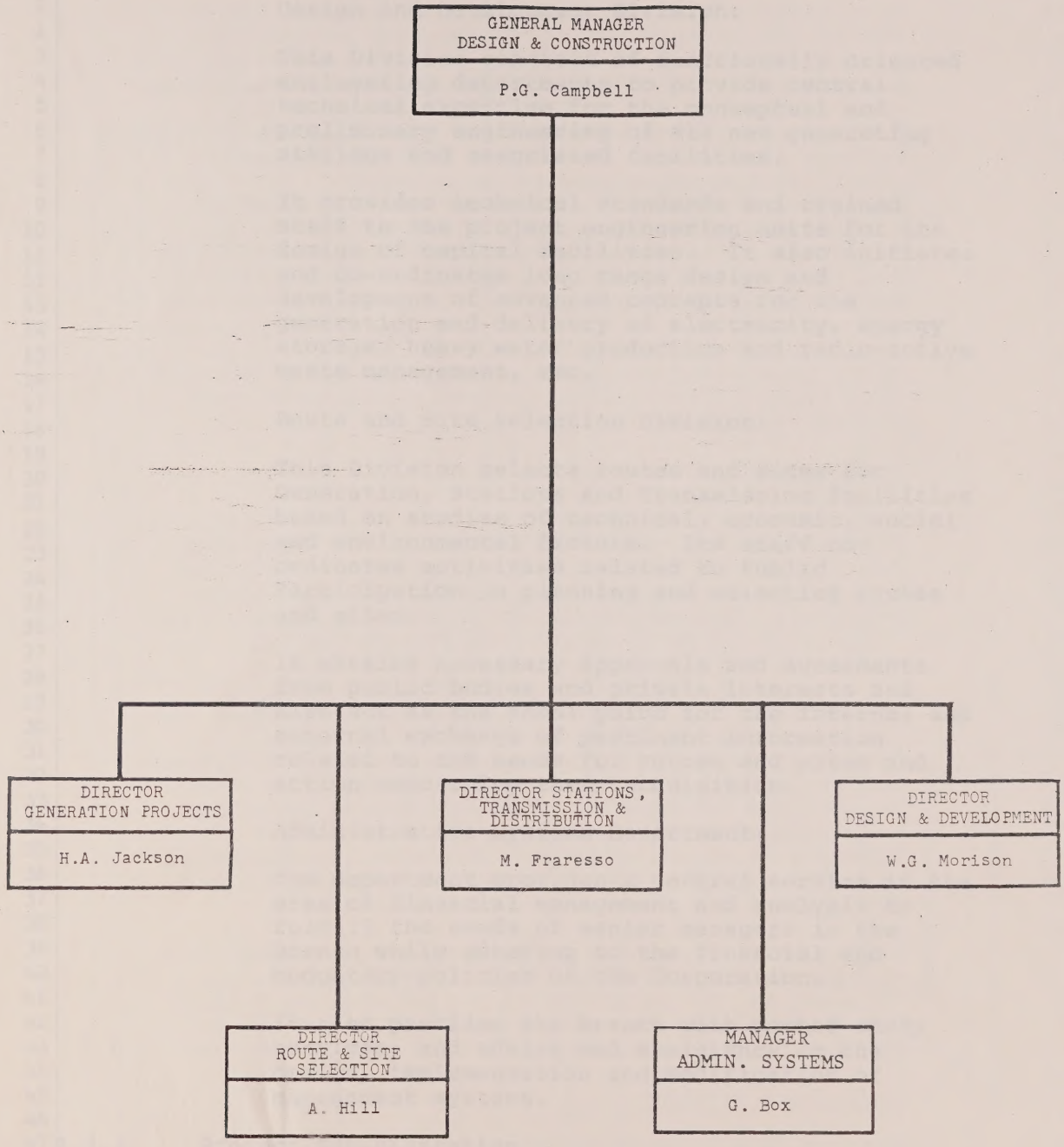

Figure 7 - 1

ORGANIZATION - DESIGN & CONSTRUCTION BRANCH

Line Number

Design and Development Division:

This Division consists of functionally oriented engineering departments to provide central technical expertise for the conceptual and preliminary engineering of all new generating stations and associated facilities.

It provides technical standards and trained staff to the project engineering units for the design of capital facilities. It also initiates and co-ordinates long range design and development of advanced concepts for the generation and delivery of electricity, energy storage, heavy water production and radio-active waste management, etc.

Route and Site Selection Division:

This Division selects routes and sites for Generation, Stations and Transmission facilities based on studies of technical, economic, social and environmental factors. Its staff co-ordinates activities related to Public Participation in planning and selecting routes and sites.

It obtains necessary approvals and agreements from public bodies and private interests and also act as the focal point for the internal and external exchange of pertinent information related to the needs for routes and sites and action concerning their acquisition.

Administrative Systems Department:

The department provides a central service in the area of financial management and analysis to fulfill the needs of senior managers in the Branch while adhering to the financial and budgetary policies of the Corporation.

It also provides the Branch with method study services, and advice and assistance in the design, implementation and modification of management systems.

7.2.3 Project Administration

The Project Management function, for all major projects, is carried out by Ontario Hydro.

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Each major project is assigned to a Project Manager who is accountable for the successful achievement of project objectives. Included in his organization are managerial support services which include scheduling, cost estimating and control, procurement and accounting. These services are supervised by a Manager of Services or Project Services Engineer.

Reporting to the Project Manager are a Manager of Engineering and a Manager of Construction who are responsible for the ongoing activities of designing and building the assigned project. Construction or engineering may be contracted out to consultants or contractors.

Major generation projects proceed through a "Project Life Cycle" which defines phases of the work from Concept to Operation. (Figure 7-2).

Concept Phase

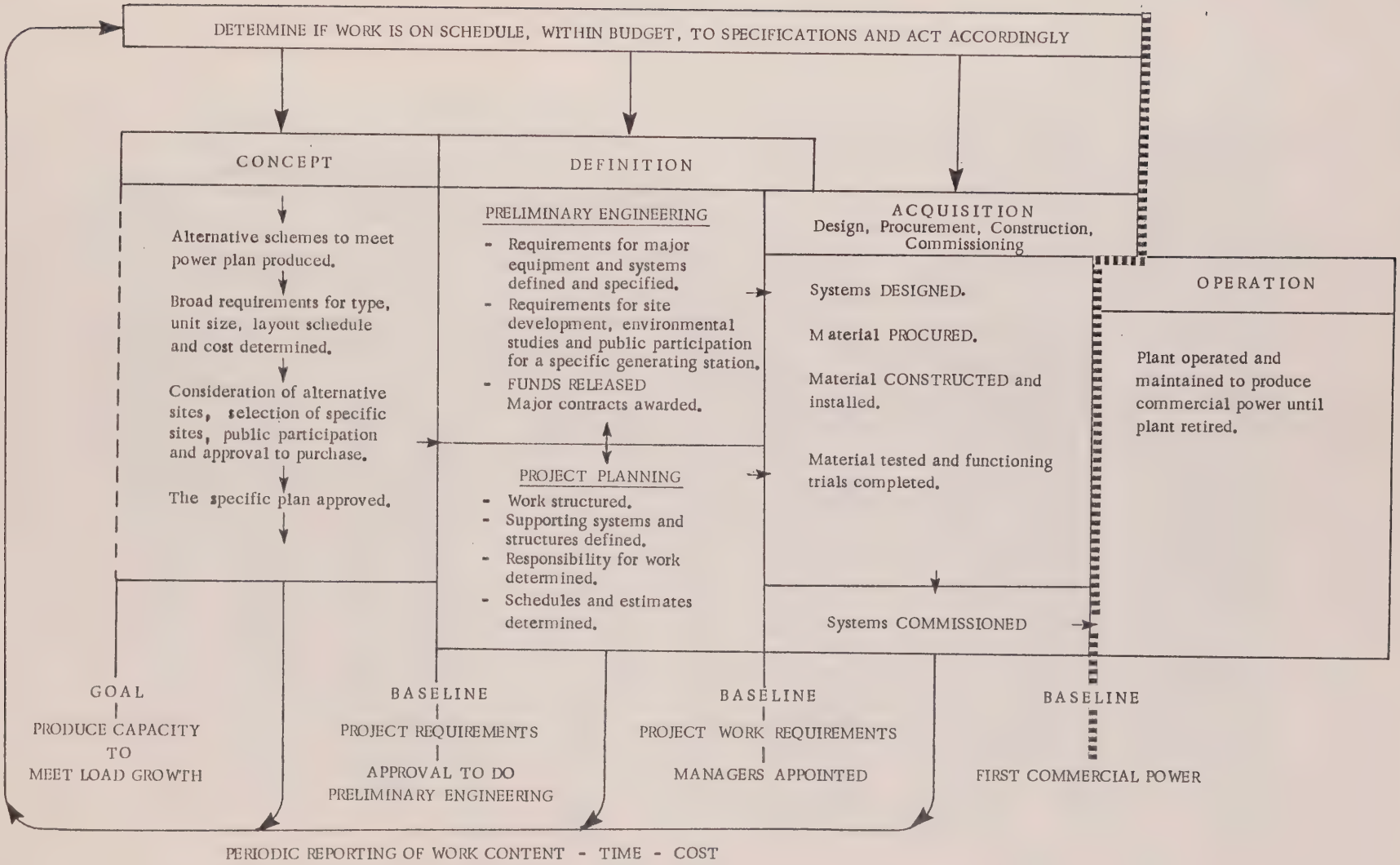
A continuing function of the Generation Planning and Development Department of the Design and Development Division is to initiate and co-ordinate activities related to developing concepts for new generating stations. The purpose is to provide management with a range of feasible options in the generation expansion and planning process.

The work is highly iterative, and the Department co-ordinates its activities with at least seven divisions within the Corporation. Several government ministries and outside companies are also involved. In addition to the base of technological knowledge required, this phase assesses the capacity of industry to supply projected hardware requirements, manpower and financial resources, constructability and operability of each proposed alternative.

During this phase, and as specific requirements for new generation are made known, activities are focussed on the selection of suitable sites. This brings into play the entire cycle of submissions for government approvals and public participation.

Definition Process

Working from a requirement initiated by System Planning Division, the project is defined and specified as to broad parameters (siting, performance, reliability, cost, etc) by the Design and Development Division. In order to ensure



PROJECT LIFE CYCLE

Figure 7 - 2

Line Number

continuity of the engineering process the preliminary engineering studies are coordinated by the individual who will become the Manager of Engineering for the project. The output from this phase comprises requirements and preliminary design descriptions (specifications) for each of the plant systems.

At the same time, the Generation Projects Division develops the specific management information systems and supporting procedures which will be needed. These must be compatible with overall Divisional standards so that comparisons of vital data and experience may be made. Plans are formulated at this time for construction processes, and for ensuring that all logistical requirements are met both in Head Office and the Field.

Finally all available information is consolidated into work packages which define the scope and terms under which work is committed to supervisors, and by which results are monitored and assessed. Work packages are developed for each system or sub-system and include such specifics as:

- Reliability and maintainability requirements
- Flow diagrams
- Design descriptions
- Schedule
- Estimated costs (dollars and man-hours)

With this information, project personnel are able to proceed with production design.

Acquisition Process

By this stage the Project Manager and his staff will be fully established in the Generation Projects Division or a consultant selected. Staff committed full-time to the project activities will be brought together to work within an integrated organization whose sole objective is the realization of the project.

Project design is carried out either in Head Office, or at the Consultant's offices, together with the initiation of procurement documents. These efforts result in documents, such as:

- Engineering drawings and specifications
- Materials and equipment lists
- Equipment specifications
- Purchase requisitions

Line Number

The administration of supply contracts is carried out with the assistance of Supply Procurement Division. In parallel with these design activities the Manager of Construction begins to put his field organization into place. As a result of his earlier planning, construction equipment and facilities will be ordered. With the securing of necessary approvals site preparation can proceed and first concrete can be poured. The main construction activities will build up upon receiving the required flow of information from the engineering office.

Construction proceeds until final testing of equipment and systems. Finally commissioning tests will lead to equipment acceptance and takeover by the operating staff of the station.

Throughout the Acquisition phase, the whole pre-planned sequence of management information reports and review meetings will be operative. These form the basis for assessing project status, progress, and the need for executive action. (These processes are described in Section 7.3)

7.2.4 Use of Consultants and Contractors (Make or Buy)

It has been the policy of Ontario Hydro since 1958 to undertake its capital construction program with a combination of its own staff and outside resources.

Procedures were developed over a number of years based on experience in undertaking engineering and construction of the power system using a variety of different arrangements.

This policy was reviewed and reported by Task Force Hydro in its report number five entitled "Hydro in Ontario, A Policy for Make or Buy" presented to the Committee on Government Productivity on June 29, 1973.

Ontario Hydro undertakes, with its own Design and Construction organization, work of a repetitive nature or of a type which requires a high degree of liaison between its design and construction organization and its planning and operating organization. Efforts are made to maintain a level of staff sufficient to provide continuity and retain technical expertise. In general, work is carried out by outside resources when the following conditions exist:

Line Number

1. When the work load exceeds the capacity of Ontario Hydro's design and construction organization, for example, when there is a need to meet compressed schedules and short-term or unforeseen work, is encountered.

2. When to undertake the work would mean, overall, an unsatisfactory allocation of staff resources. (eg hydraulic projects)

3. When work is of a specialized nature requiring knowledge, equipment and techniques not possessed by Ontario Hydro, or when it is not of a continuing nature. (eg Micro-wave communication systems, oil storage farms, fuel handling systems, specialized studies)

4. When work is of a conventional nature not directly associated with power production (eg construction of office and service buildings).

5. Where it has been determined that work can be performed more economically by contracting. (eg design or supply of transmission towers and aerial photographic surveying)

6. Installation work in connection with heavy equipment (turbines and generators) and underground H.V. lines is handled by contract because the on-site assembly is an integral part of the suppliers warranty.

In general, it has been found that the use of internal resources provides a more positive control of schedule commitments and of the overall cost of the projects. It has also provided for a shorter overall project schedule in that construction may proceed as the design work is developed. This results in a reduction in interest costs and also makes possible a later project commitment date providing a potential for further savings.

Feedback of construction methods to be used and previous operating experience into the design stage is easier if internal resources are used for the design and construction of the main features.

To a significant extent the skills required in design and construction of large generating stations are unique to Hydro in this Province. Adequate outside resources in terms of both volume and expertise are limited.

Line Number

Over time, Hydro has continued to monitor its performance in comparison to outside agencies by reviewing the results of contracted work. The results of this analysis have been mixed (eg design of transformer stations is more costly by contract; construction of wood pole transmission lines can be cheaper by contract). The information made available is used to assist in making better choices as to who will undertake future work.

In order to transfer expertise and experience to the private sector, as recommended by Task Force Hydro, the Design and Construction divisions have moved to establish an environment for increased "Buy". This requires refinement of control systems so that better comparisons of performance can be developed, at the same time permitting a dynamic response to changing conditions.

While the Corporation employs its own forces for much of the design and construction effort, the majority of its capital plant is bought. Such purchases include a significant engineering component. Figures 7-3 and 7-4 illustrate the magnitude and trends of the percentage of actual "make" in the Design and Construction Divisions. Trends in engineering and construction services are also illustrated.

7.2.5 Construction Manpower

Based on the committed generation program Ontario Hydro forecasts its needs for construction tradesmen. This forecast covers all manpower whether employed directly or by contract.

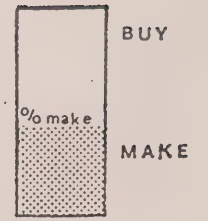
It is estimated that the greatest needs will be in the pipefitting, pipe welding and electrician trade categories. The greatest demand by location will be in the Toronto and Bruce Peninsula area.

At the present time the demand for construction trades is satisfied by both recruitment and on-the-job training. Many of the work operations in the construction of a nuclear generating station demand a degree of skill beyond that needed for conventional heavy construction. Ontario Hydro's experience is that it must conduct extensive training courses at the site in order to meet these requirements. The

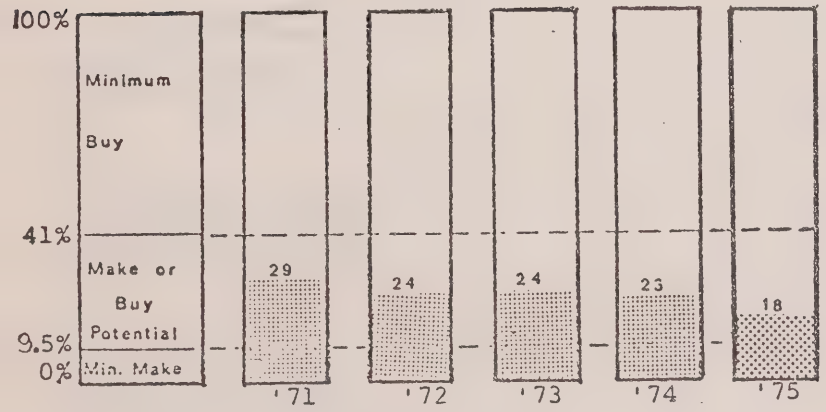
MAKE AND BUY STATUS

AS A PERCENTAGE OF TOTAL EXPENDITURE

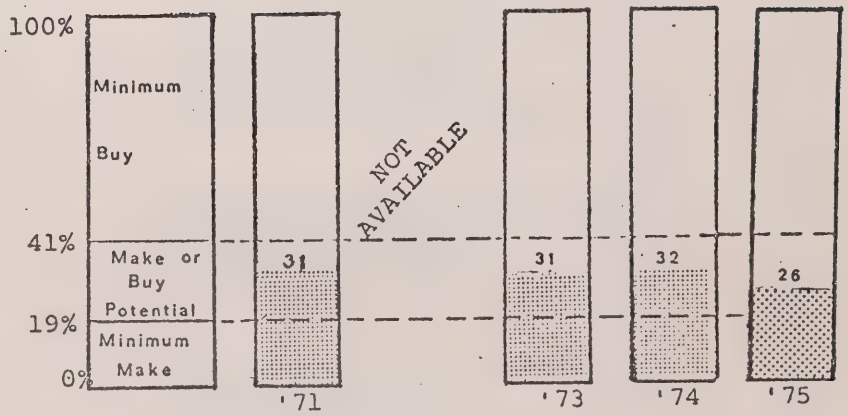
Figure 7 - 3



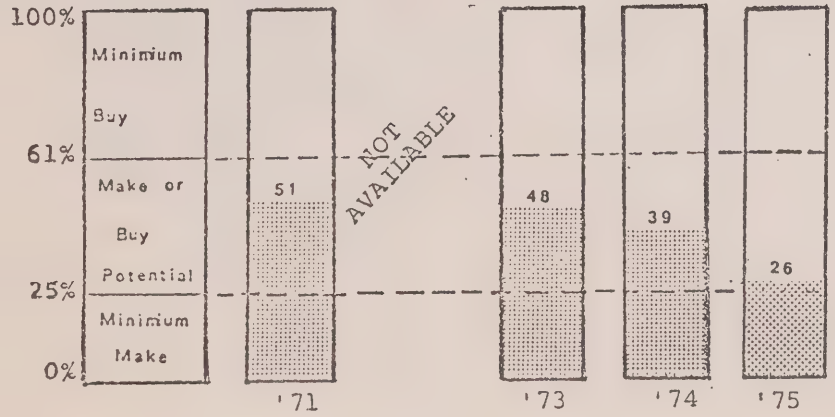
GENERATION PROJECTS



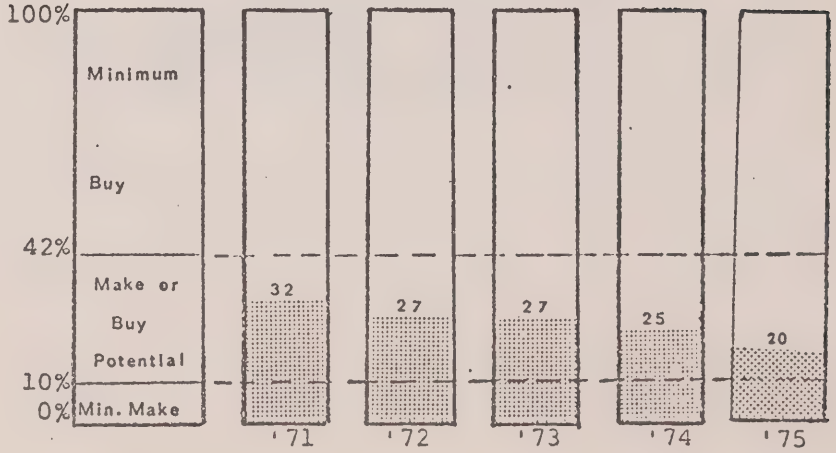
STATIONS PROJECTS



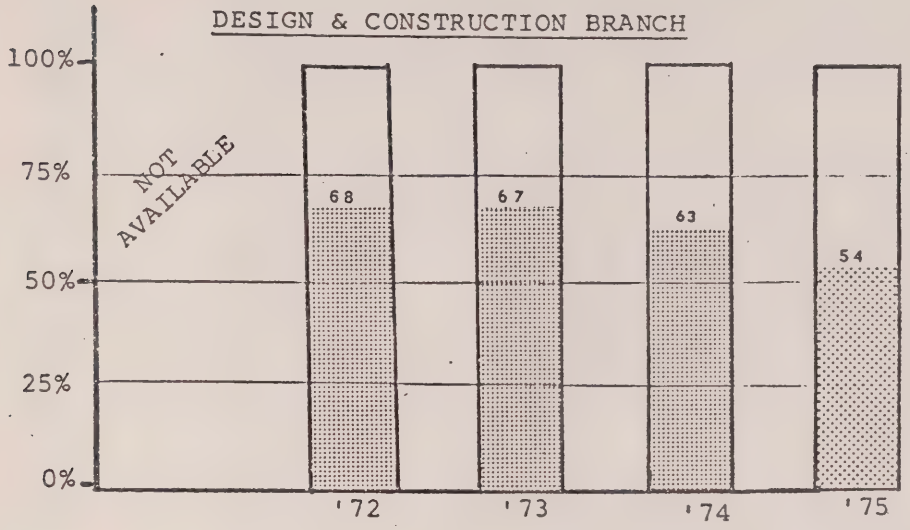
T & D PROJECTS



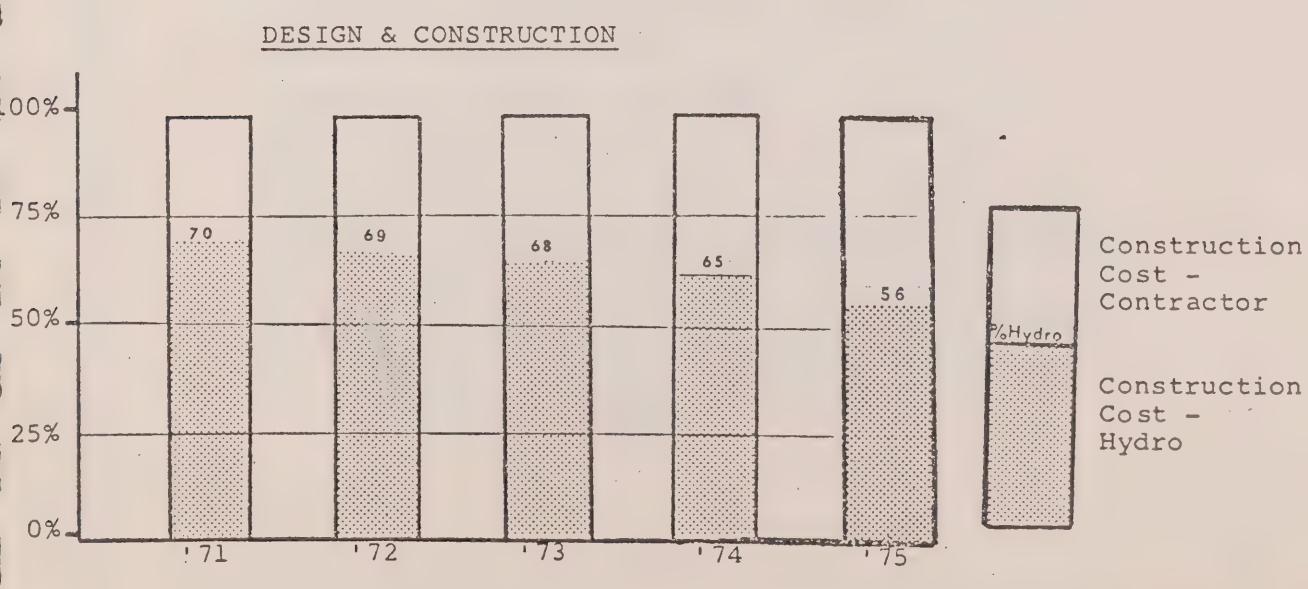
DESIGN & CONSTRUCTION BRANCH



ENGINEERING COST: HYDRO/ENGINEERING SERVICE CONTRACT - Figure 7 - 4



CONSTRUCTION COST: HYDRO/CONTRACTOR



Line Number

most pressing need is for welders qualified to work to nuclear code requirements. During the construction stage of a typical project the skill level of many welders will be upgraded in order to meet the project need.

The construction trades are a relatively mobile work force and tend to migrate to large projects when no work is available near their homes. Virtually all of Ontario Hydro's work is done by union tradesmen so that unions are heavily relied upon to supply the men required. If they are unable to do so Ontario Hydro does its own recruiting. Ontario Hydro projects are in competition with all other construction work for skilled tradesmen; however, it is important not to offer incentives above those required in collective agreements, as to do so would add to the cost of all construction work.

The Ontario Labour Relations Act provides for accredited associations in the various sectors of the construction industry. Electrical power systems construction has been defined as a seperate sector. The Electrical Power Systems Construction Association (or E.P.S.C.A.) is an association of employers including the Corporation who are engaged in construction work for the Generation Projects Division and the Lines and Stations Construction Department of the Stations, Transmission and Distribution Division.

E.P.S.C.A and members of the Allied Construction Trades Council have signed a collective agreement covering such items as uniform working conditions, special employment conditions, effective utilization of manpower, resolution of jurisdictional disputes and apprenticeship training.

7.3 PLANNING AND CONTROL PROCESSES

7.3.1 Approval and Release

Most of the work which is carried out by the Design and Construction Branch results from projects which have been planned and committed by the System Planning Division following an evaluation of various alternatives. As a result, the Branch's work load and associated level of costs are largely dependent on the number of projects assigned to it by the System Planning Division.

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Work is planned and committed by the Branch itself including distribution lines and stations, and some work associated with modifications to existing generating stations. Work on developing engineering standards, conducting environmental studies, conceptual design of new generating stations, and other similar engineering activities are also planned and committed by the Branch.

The amount of work and expected cost of each project is defined by a project Work Order. This Work Order is also broken down into annual periods as part of the budget process. The procedures governing the initial approval and subsequent modifications to these work orders are outlined in the Capital Construction Program and Procedures Manual.

For the projects underway, planning is carried out on an on-going basis both at Head Office and Field locations with the three major concerns being the adequacy of the detailed design, achievement of in-service dates and control of costs. The main factors determining the effectiveness of the planning effort are the predictability of approval, the availability of engineering and construction resources and the ability of the manufacturers to meet the required material delivery schedules.

Almost all of the work undertaken by the Design and Construction Branch is subject to two approval systems, namely, the Capital Construction Program, and the annual Program Budget.

(i) Capital Construction Program (CCP)

The CCP deals with the release and approval of individual projects over the total life cycle. It is reviewed annually by the Board of Directors via the Capital Construction Program submission. This submission is prepared and co-ordinated by System Planning Division. In addition, the CCP procedures describe the process for the on-going review of projects.

(ii) Program Budget

The Program Budget deals with expected annual levels of cost and work for all projects, with particular emphasis being placed on the budget year. Initially, budgets are prepared at a project or program level. These budgets are then gradually condensed and summarized as they

are reviewed and, if necessary, modified at Department, Division and Branch levels before receiving Corporate approval.

7.3.2 Resource Planning

It is essential to ensure, in advance, the availability of the property, equipment, materials and manpower required to carry out a project. Although resource planning is primarily done by project, manpower planning must also be done on a program or Branch basis. The effectiveness of resource planning is reflected in both total project and annual costs. Generally resource planning activities can be divided into the following areas:

(a) Property Acquisition

The acquisition of the property for new sites and rights-of-way is a prerequisite for most Design and Construction activities.

(b) Equipment and Materials

Proper planning of equipment and materials is vital to the success of each program. Extensive long and short-term planning is conducted by Branch personnel in conjunction with the Supply Procurement Division.

Planning is especially important for major equipment such as turbine generators, fossil-fired boilers, reactor core structures, transformers, and steam generators where capable sources of supply are very limited.

Because of their long lead times, the manufacture and delivery schedules for major equipment form the basis for the overall project schedule. Serious delays will have adverse effects on the project cost, in-service dates, and anticipated annual expenditures.

The requirements for other materials such as concrete, cable and piping are determined as the detailed design proceeds. Much of this material is purchased in bulk quantities to reduce cost. Delivery dates are arranged to meet project requirements and accommodate manufacturing capabilities.

(c) Engineering

Engineering planning should ensure an adequate supply of engineering, technical, drafting and clerical skills to carry out the project. These skills can be obtained inside Hydro or from outside companies.

(d) Construction

Construction planning covers the physical project construction and the administration of the construction forces.

Planning the administration resources ensures an adequate supply of skills to carry out duties such as field engineering, materials control, contract administration, construction planning, accounting and construction trades supervision. In addition it provides for adequate office, warehouse and on-site fabrication facilities to meet anticipated construction requirements.

The physical construction of the project requires a detailed plan for the installation and testing of the plant. Related to this is an extensive on-going planning effort to determine an adequate level of construction trades resources. Trades such as electricians, equipment operators, steamfitters, boilermakers, welders, carpenters, masons and general labourers are included. In addition to manpower, the planning effort determines requirements for work equipment, scaffolding, formwork and other construction materials. The construction work is carried out by a combination of Hydro and outside resources.

7.3.3 Components of the Project Management Systems

Virtually all work activities within the Design and Construction Branch are charged to, and therefore controlled by, a work order system. Approximately 90 per cent of Head Office costs and 100 per cent of field costs are charged to Capital Construction work orders which have received Board of Directors' specific approval at the commitment stage of major projects or general approval in the case of small projects. The balance of the work, which is not chargeable to specific capital projects, is paid for by funds released and controlled according to

Line Number

responsibilities outlined in the Signing Authority Register and Annual Budget.

After a plan is committed, a work order is issued for each project under the plan. Work orders define the scope of work and state its estimated cost. They provide a vehicle for collecting costs and distributing expenditures. Computerized ledgers summarize costs for review and for final capitalization.

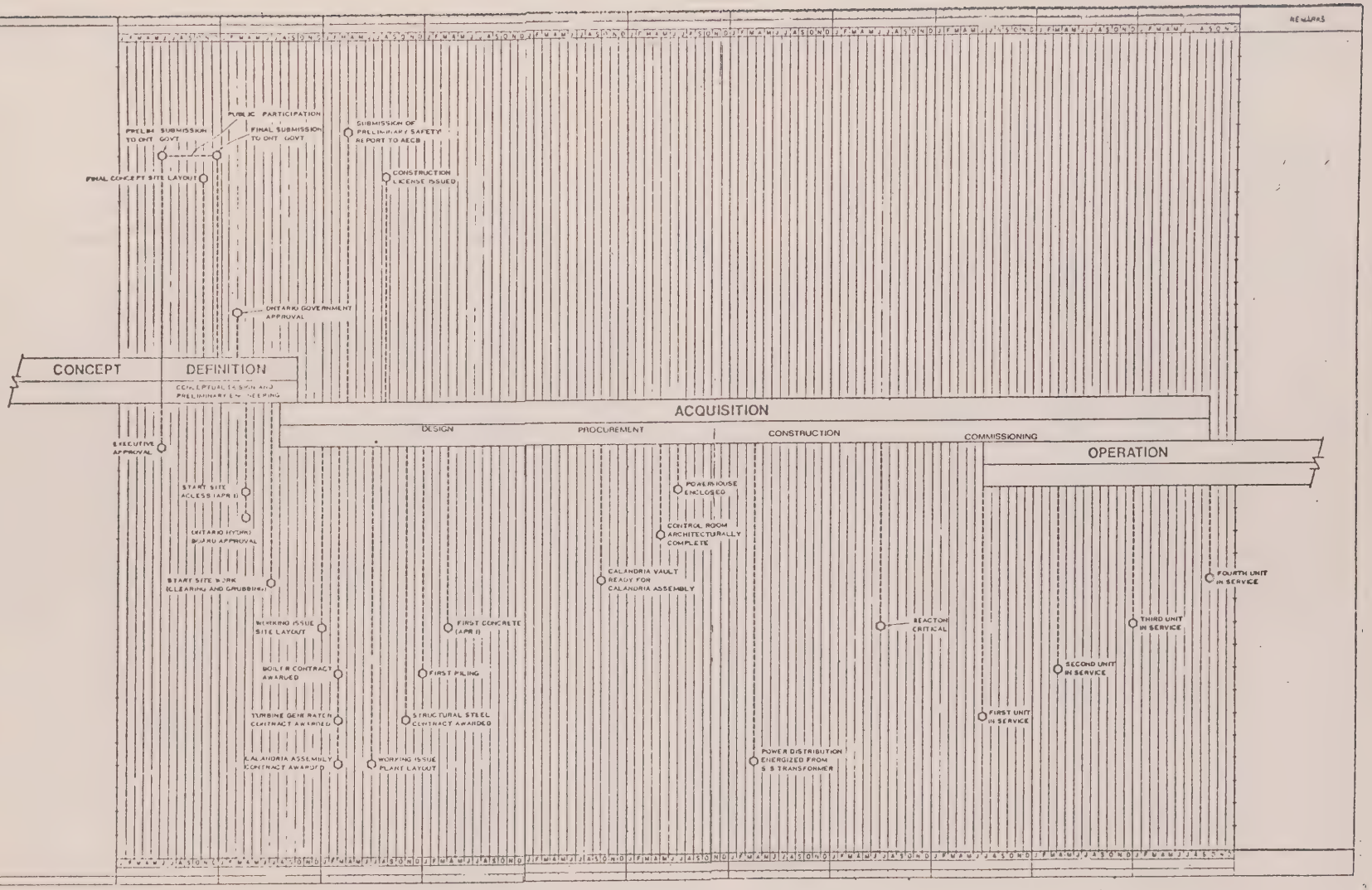
The project is assigned to a project manager who is responsible for carrying out the work in accordance with the authorization and for the proper allocation of charges. The first task of the manager is to see that overall project objectives are set and then refined into specific assignments (work packages) which are, in turn, delegated to the various departments and sections who will do the actual work.

The work order is reviewed and controlled throughout all phases of the project. Signing authorities govern the limits of action which individuals at various levels may take.

The varying size and diversity of individual projects, and the magnitude of the total capital construction program, require effective management control systems. The systems actually employed vary in their sophistication depending upon the project. For smaller jobs, a relatively simple standardized approach is used. For the larger jobs, more comprehensive management systems have been developed incorporating the concepts of project life cycle, work breakdown structure and system classification index.

7.3.3.1 Project Life-Cycle

For large projects the project life cycle is broken down into separate but overlapping phases covering Concept, Definition, Acquisition, and Operation as described previously in section 7.2.3. Key event dates are determined, from executive approval to the in-service date of the final unit (see Figure 7-5). When overall project parameters are established, a work breakdown structure is developed on which schedules are based and responsibilities assigned.



TYPICAL NUCLEAR MASTER SCHEDULE

Figure 7 - 5

Line Number

7.3.3.2 Work Breakdown Structure

A work breakdown structure (see figure 7-6) formally subdivides major projects into a hierarchy of "work packages" which form the basis for:

(1) Assigning responsibilities for work to be done (both in design and construction);

(2) Defining all schedule documents;

(3) Defining packages for estimating and controlling costs;

(4) Material control.

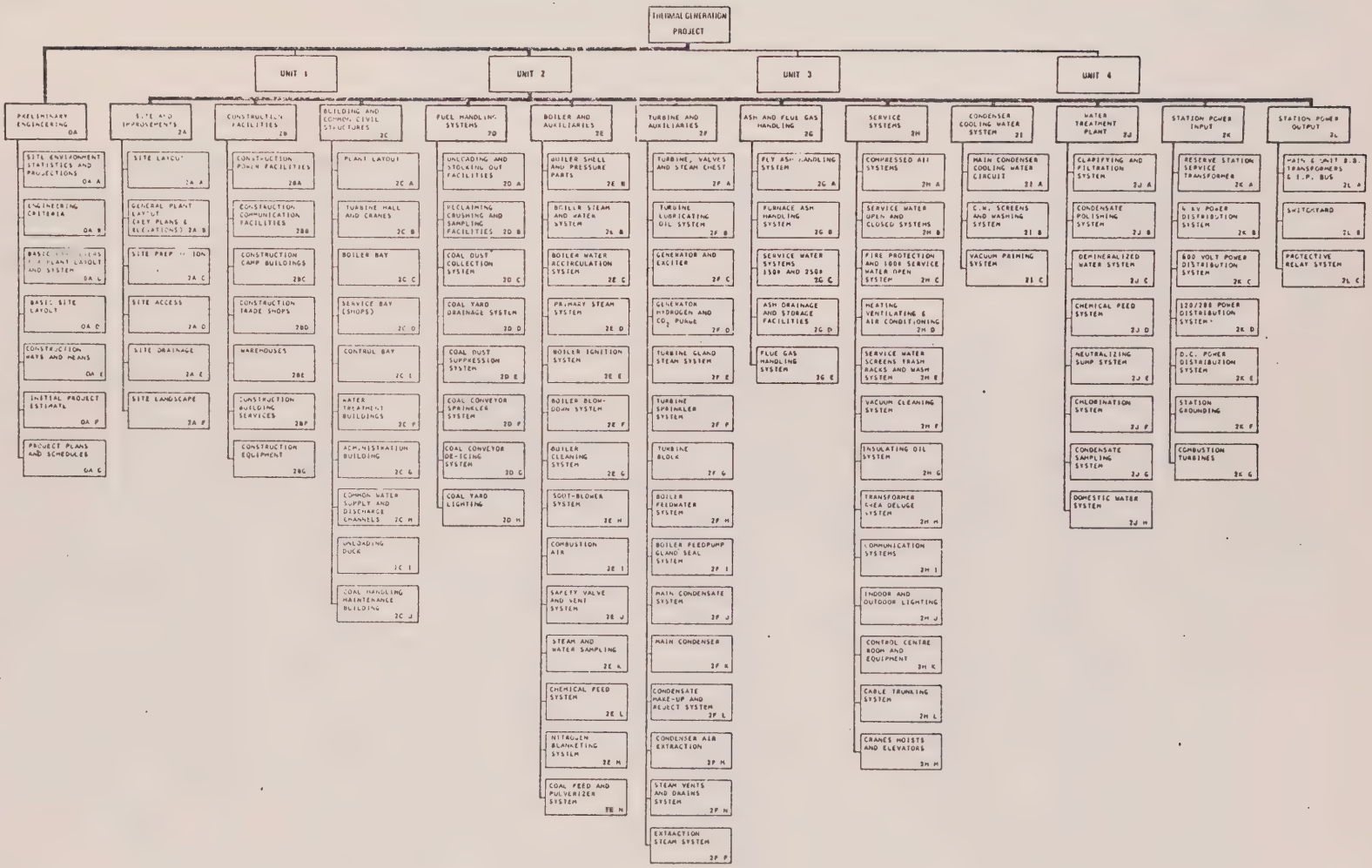
Each work package document includes:

- an identification of the system;
- a clear description of the work package itself including a description of the limits of the package;
- a breakdown of the contents;
- a description of the relationship between work packages.

7.3.3.3 System Classification Index

A hierarchical numbering index is used to identify all hardware and documentation throughout the project life cycle, through uniform application on a system and component basis. This Classification System is applied to the following:

- work breakdown structure;
- plans and schedules;
- cost accounts;
- procurement documents;
- drawings, engineering data, and manuals;
- correspondence and other records;
- plant and equipment labels;



WORK BREAKDOWN STRUCTURE - TYPICAL GENERATION PROJECT

Figure 7 - 6

Line Number

7.3.4 Scheduling

The scheduling system has been designed to meet certain key objectives:

- enable management to establish a feasible plan and to relate status and progress to what has been planned.

- provide scheduling information that will show the user what he has to do, how he will do it (sequence), what resources he will use to do it and when it will be done.

- provide management at all levels with timely summarized scheduling information.

Using the work package approach, responsibility is allocated to specific line supervisors or managers for the planning and scheduling of the work. Where that responsibility lies outside the immediate organization, suppliers and contractors are obliged to provide schedules and progress reports.

Three levels of management are provided with schedule information of different scope and scale.

At the Project Manager's level, schedule commitments are related to strategic milestones with specified completion dates. Project schedule performance is regulated by adjusting resources and setting priorities while maintaining control over major expenditures.

The next level of schedule is used to plan, direct, co-ordinate and control the composite production efforts of all contributing resource groups, including external organizations such as consultants and equipment suppliers.

The third and most detailed level of schedule is used by those supervisors who directly control the work.

The master schedule for one generating unit might cover about 100 major activities and their interdependencies. The co-ordinating and control schedules would include over 12,000 activities to ensure all significant inter-relationships are covered. Production level schedules in total would cover about 60,000 activities. These figures are typical for one unit of a conventional generating

station and could be 25 per cent higher for a nuclear unit.

7.3.5 Estimating, Reporting and Cost Control (ERCC)

The ERCC system is used for estimating, reporting, and forecasting the cost of work packages and total project cost taking into account design, construction, and procurement commitments.

Each work package is broken down into cost elements relating to construction, permanent material and contracts, and engineering. These three elements are summarized by computerized reporting systems and when combined give the total project cost (see Figure 7-7).

The objectives of this approach are:

(i) Improved estimates through accurate collection of cost data and realistic comparative information between projects, features and systems.

(ii) Effective reporting of cost trends and variances to management for review and corrective action.

Typically, the total project cost is produced in three categories as follows:

(i) Construction Work Order

The Construction Work Order includes all construction direct costs and indirect charges, property acquisition, site preparation, supply and erection of all permanent equipment and facilities.

(ii) Engineering Work Order

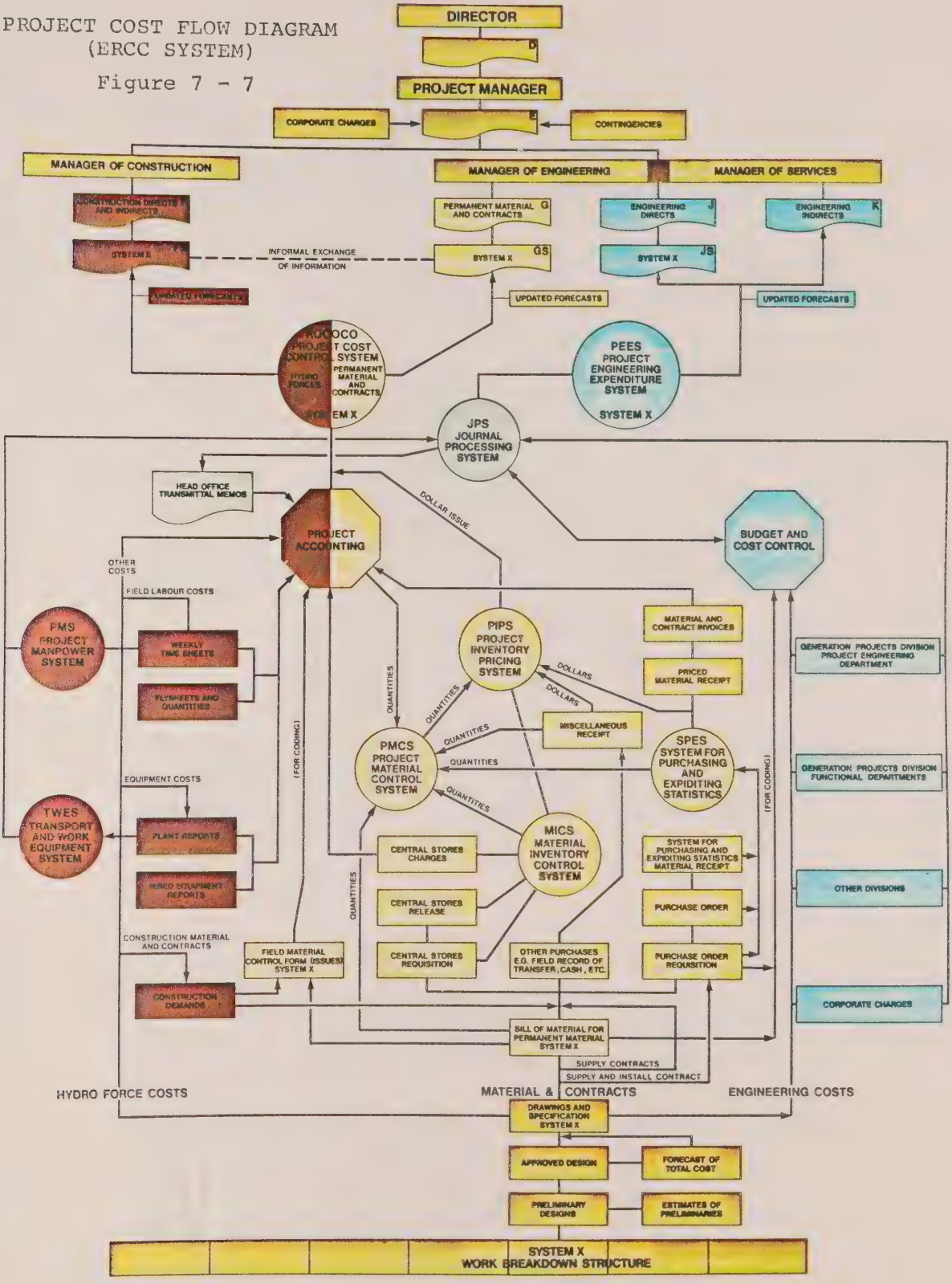
The Engineering Work Order includes all charges for engineering work done by Hydro and consultants, and all supporting services such as computer, supply inspection, research, legal, administration overheads, interest during construction, and contingency allowance.

(iii) Commissioning Work Order

The Commissioning Work Order includes all costs and revenues associated with commissioning.

PROJECT COST FLOW DIAGRAM
(ERCC SYSTEM)

Figure 7 - 7



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7.3.6 Progress Reporting and Control

The Project Manager is responsible for the progress of the project, total project expenditures, and explanations of variance. Directly reporting to him:

- The manager of construction is responsible for the commitment of all field resources, and for control of expenditures against control estimates.

- The manager of engineering is responsible for all engineering and service costs, permanent materials and contracts, and financing charges.

Each area assigned the responsibility for work packages reports upwards as shown on the Project Cost Information Flow diagram illustrated in Figure 7-8. Costs are reported in three main streams being Construction, Permanent Materials and Contracts and Engineering.

Control is effected through summaries which give the manager up to date and predictive information about the progress of important tasks so that he can take appropriate action.

The total work order is reviewed each month comparing planned expenditures and progress against actual expenditures and progress. Action is taken by the appropriate management level where the variance or rate of change warrants.

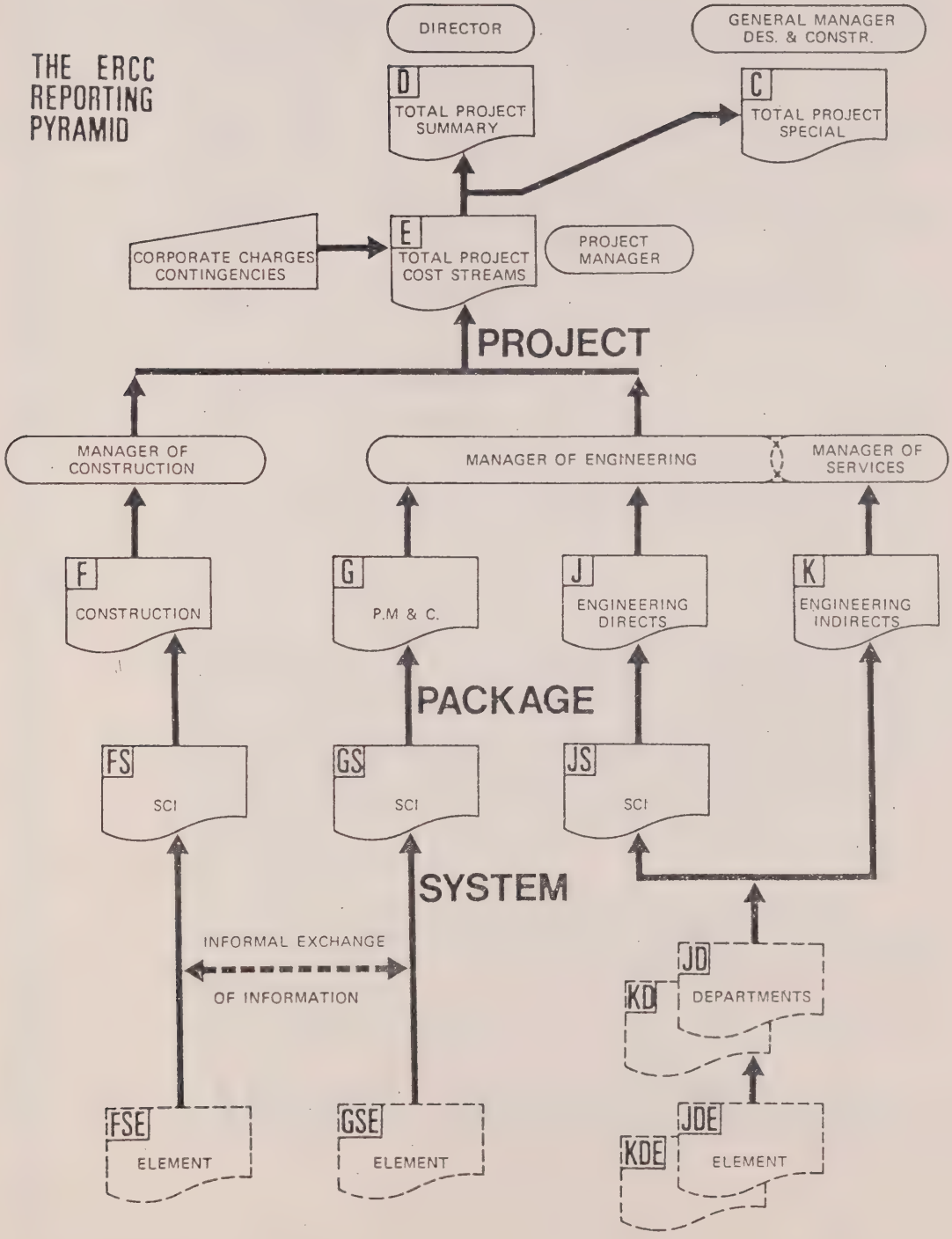
Review Meetings

Weekly meetings are held to review status reports produced by the monitoring systems, and to identify areas requiring management action to resolve problems. Although design/construction dialogue is continuous, combined meetings are held when significant changes in plan or re-allocation of resources are required.

Bi-monthly senior management review meetings are held for each major project, chaired by the General Manager - Design and Construction and attended by Directors from the Design and Construction, Operations and Services Branches. The purpose of these meetings is to identify problem areas which

PROJECT COST INFORMATION FLOW

Figure 7 - 8



require the attention of senior management, and to establish a positive program for resolution.

7.4 Procurement Management

The procurement process is the series of activities which ensure that goods are made available and ownership is transferred to Ontario Hydro.

Procurement activities fall into two major time frames; the pre-tender and the post-tender periods.

In the pre-tender stage, emphasis is placed upon technical requirements and schedules, bidders lists, contract standards and invitations to tender.

The major portion of the post-tendering work comprises evaluation and selection, contract administration and quality assurance.

7.4.1 Pre-Tender Processes

7.4.1.1 Technical Requirements and Schedule

The technical specification defines the technical, functional and quality requirements of the work. Delivery requirements are also determined and specified.

7.4.1.2 Bidder's List

The designer and the purchasing group may assemble a bidder's list for the procurement of the required products. A supplier must be able to meet design requirements. Other factors which are considered include past performance and the ability of the supplier to do the present work, including not only their manufacturing capability but also their financial resources and present work load.

7.4.1.3 Contract Standards

In addition to the technical requirements, the tendering documents include a number of other items such as commercial conditions, and labour relations requirements.

7.4.1.4 Invitations to Tender

Invitations to tender are made by public advertisement or by invitation to those companies on the bidders list. Normally public advertising is

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used for service contracts and general works contracts such as road building and excavation. Specialized manufacturing contracts are most often handled by invitations to selected bidders.

7.4.2 Post-Tender Processes

7.4.2.1 Evaluation of Tenders

Following receipt of the tenders, whether requested by public advertisement or from a selected bidders list, an evaluation is undertaken. Tenders not meeting technical or delivery requirements are rejected.

An economic evaluation is then carried out and combined with an evaluation of the other facets of the suppliers qualifications, forms the basis of the final recommendation. Final approval is given by the Board or an appropriate level of management.

7.4.2.2 Contract Administration

Post-tender activities include final clarification of the technical details of the tender and the general contract administration. The responsibilities for these activities are divided between three functions within the Corporation. The engineering department is responsible for preparation of the contract, and the approval of the engineering done by the supplier including drawings, design changes including those requested by the supplier. The Supply Procurement Division has the responsibility for monitoring the manufacturing schedule, approving the quality program of the manufacturer, approving manufacturing schedule changes, and monitoring supplier performance. The construction department approves the original installation schedule and any changes of delivery which may eventually affect that schedule. The final acceptance of the equipment and the final payment approval is the responsibility of the project manager.

7.4.2.3 Quality Assurance

The approval of the suppliers quality assurance plan is the responsibility of the procurement department which purchases the product. An Inspection Plan is required by Hydro's quality assurance program. A letter of approval of the inspection plan is returned to the manufacturer following general acceptance. According to the value of the contract and the time

estimated for manufacturing, different levels of activity are required. In a long-term contract of considerable value and complexity, progress reports on production activities are supplied to Hydro on a regular basis. These are reviewed by the procurement department and forwarded to the Manager of Engineering and Manager of Construction for appropriate action.

7.5 COMMISSIONING AND PLACING IN-SERVICE

7.5.1 Commissioning

Commissioning starts when the first equipment is turned over to Operations Branch and continues until all generating units are declared In-Service. This includes inspections, filling of service and process systems with operating fluids, energizing station apparatus required for power production, performing operation testing, placing systems in operation and functional testing of apparatus. All commissioning activities are identified and planned by the Thermal Generation Division or Nuclear Generation Division. Activities are programmed to meet the earliest possible in-service date.

Following turnover, the Design and Construction Branch retains the prime responsibility for design decisions as well as an obligation to assist Operations in the correction of deficiencies, whether they are known at the time of turnover or are identified by commissioning and operation.

Commissioning experience and problems are reviewed and documented by Engineering and Operations to benefit the design, operation, maintenance and reliability of future generating stations.

7.5.2 In-Service Criteria

The In-Service Date is the date on which a generating unit is officially declared In-Service. The date is agreed to between Director, Thermal or Nuclear Generation Divisions and the Director, Generation Projects Division.

Normally, a generating unit will be declared In-Service when the following conditions exist:

(1) The essential commissioning of the unit is complete.

(2) The unit has achieved full power.

(3) Problems encountered during commissioning have been overcome to such a degree that the unit is predicted to operate with the reliability expected for the first year of operation.

A unit may be arbitrarily declared In-Service when some of the above conditions do not exist. Such arbitrary declaration would be made in unusual cases such as a unit not being able to reach its design capacity or reliability for an extensive period. In this case, the commissioning would be terminated and the unit made available to the power system with lowered capacity or poor reliability.

7.5.3 Commercial In-Service Values

All the costs of making a generating unit available for commercial operation are treated as capital expenditures.

The value of energy supplied to the power system by a generating unit being commissioned is credited to the capital cost.

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RELATED MATERIAL

1. Capital Construction Program - Forecasting and Reporting System (CAPFOR)

2. Capital Construction Program and Procedures Manual

3. Construction Expenditure System (CES)

4. Purchasing Policy and Procedures Manual

5. Scheduling System Procedures Manual (GPS)

6. Estimating, Reporting and Cost Control (ERCC) System Manual (GPC)

7. Project Material Control System Manual (GPM)

8. Project Inventory Pricing System Manual (GPI)

9. Procurement Procedures Manual (GPP)

10. System Classification Index (SCI)